LANL Syllabus/Schedule

Description

This training course provides an overview of how to perform nuclear criticality safety (NCS) evaluations (NCSEs) in accordance with the guidance in DOE-STD-3007, applicable ANSI/ANS series 8 standards, and DOE Orders and Standards.

The course provides a review of NCS fundamentals, lessons-learned from selected process criticality accidents, an overview of ANSI/ANS-8 standards, and interpretive guidance from DOE with respect to relevant DOE Orders and Standards. Each student is assigned to an evaluation team to evaluate a fissile material process at the LANL plutonium facility, PF-4.

Course Duration

5 days

Objectives

- Review basic NCS fundamentals, process criticality lessons-learned, and history that is important in NCS evaluation development,
- Review and understand the ANSI/ANS-8 series standards and how they are used in the development of NCS evaluations,
- Review and understand the DOE Orders and Standards that are used in the development of NCS evaluations,
- Learn about the evaluation process with respect to roles and responsibilities, conducting effective walkdowns, defining normal and credible abnormal conditions, etc., and
- Work with a small team in the development of a criticality safety evaluation for a fissile material operation at the LANL plutonium facility using the principles and guidance taught in the class modules.

Prerequisites

The course attendees will benefit from have completed reading and understanding the Nuclear Criticality Safety Engineer Training Modules (1-15) available at http://ncsc.llnl.gov/trainingMain.html. The attendees shall also have a good background in reactors physics, knowledge of NCS handbooks (LA-10860-MS, LA-12808, etc.), and some practical knowledge of NCS hand calculation methods that will be useful during the evaluation development sessions.

Target Audience

The course is primarily targeted for professionals just entering the criticality safety discipline. It is also designed for current criticality safety engineers seeking to maintain technical capabilities.

Completion Requirements
Attendees must complete the week-long training session and have satisfactorily completed the in-class evaluation and presentation of results.

Instructors
Doug Bowen, Shean Monahan, Jim Baker, Mark Mitchell & Chuck Harmon

Sandia Syllabus/Schedule

SNL SPRF/CX Hands-On Critical Experiment Training Course

Basic Schedule

Role course is intended to play in overall training & qualification of **nuclear criticality safety engineer ([N]CSE) personnel**
Design for flexibility; can be tailored for audiences of operations and/or management personnel, as well non-DOE and non-U.S. audiences

Monday	Tuesday	Wednesday	Thursday	Friday
Introductions BLOCK 1 Fundamentals	BLOCK 5 Hands On #1: Experiment – Fuel Approach to Critical	BLOCK 5 Hands On #2: Experiment – Water-Height Approach-to-Critical	BLOCK 5 Hands On #3: Demonstration – Fuel Separation ("The Slot")	BLOCK 6 Results BLOCK 7 Benchmarking
LUNCH				
Intersperse Selected BLOCK 2 Critical-Measurement Accidents BLOCK 3 Critical-Experiment Design	(EXPT continued) Intersperse BLOCK 1 Fundamentals BLOCK 2 Critical-Measurement Accidents BLOCK 3 Critical-Experiment Design BLOCK 4 Critical-Experiment Execution	Selected BLOCK 2 Critical-Measurement Accidents BLOCK 3 Critical-Experiment Design BLOCK 4 Critical-Experiment Execution	(DEMO continued) Intersperse BLOCK 2 Critical-Measurement Accidents BLOCK 4 Critical-Experiment Execution	

SNL SPRF/CX Hands-On Critical Experiment Training Course

Topic Blocks
1. Fundamentals
2. Critical-Experiment Accidents
3. Critical-Experiment Design
4. Critical-Experiment Execution
5. Hands-On Critical Experiments
6. Analysis of Experiment Results
7. Critical Experiment Benchmarking

Topic Blocks
1. Fundamentals
a. Fission b. Chain reactions c. Multiplication and reactivity d. Parameters affecting criticality e. Critical experiments and parameters f. Buckling-conversion method for hand calculations g. Criticality safety data and limits h. Subcritical multiplication – theory i. Multiplication factor “continuum” i. Subcritical ii. Delayed critical iii. Delayed supercritical iv. Prompt & prompt supercritical
2. Critical-Experiment Accidents
a. Accidents and how they affect Critical Experiments i. Critical assembly/measurement accidents and lessons ii. Application of lessons in Standard ANSI/ANS-1 *Conduct of Critical Experiments* [See also #6 & #7 below]
3. Critical-Experiment Design
SNL SPRF/CX Critical-Experiment Design a. ANS-1 implications i. Administration ii. Design b. Design to replicate application i. Light-water reactors ii. LWR fuel depeletion/burnup c. SNL critical experiments i. Burnup-Credit (BUCCX) d. Seven-Percent (7uPCX)
4. Critical-Experiment Execution

Topic Blocks
a. Nuclear Instrumentation b. Approach-to-Critical Measurements (pactice) c. Conduct of critical-measurement operations d. Practical considerations
5. Hands-On Critical Experiments
a. SNL Approach on Fuel Load • Mass • Absorption b. SNL Approach on Water Height • Moderation • Geometry • Reflection c. SNL Moderation Effects • Mass • Moderation • Interaction [Consider use of videos of previous SNL, LANL, and/ or Livermore hands-on exercises that the audience will not likely have an opportunity to see live]
6. Analysis of Experiment Results
a. Perform 1/M graphing and extrapolation b. Explain of impact of spacing, reflection, and poisons on multiplication c. Compare measured data to published data and computer models d. Compare the relative worths of parameter changes
1. Critical Experiment Benchmarking
a. ICSBEP b. Anatomy of an Evaluation c. Evaluation review process d. Modeling a benchmark – practical use of an evaluation [Walk-through of SNL benchmark reports for BUCCX and 7uPCX (in progress)] i. Physical ii. Computer-code

DAF/NCERC Syllabus/Schedule

DAF/NCERC Hands-on T&EP Course Schedule

Monday @ Nevada Site Facility (NSF)		
10:00	Meet at NSF in North Las Vegas (Room TBD) to take care of any last minute DAF access, training issues, or any other logistical issues for the scheduled events for the week for participants	
11:30	Lunch	
13:15	NSF Great Basin Conference Room (not sure who is invited to attend) Defense Program Awards of Excellence Ceremony in Great Basin Conference Room	
15:00	NSF Great Basin Conference Room Don Cook recognizes Criticality Experiment Facility (CEF) Team and announces name change	
16:00	End of Day	

$30 in cash will be collected from each student at NSO to cover box lunch costs at the DAF for Tuesday - Thursday (see menu ordering and selection below)

Tuesday @ DAF Entry Guard Station (EGS)		
7:17	DAF EGS	
7:45	Planet Handstack Demo 1. ANS 8 standards versus ANS 1 Standards 2. Two Person rule as an administrative control 3. Definition of "unit" for these operations 4. Defining a "safe" starting point 5. 1/M control in approach to critical 6. Prediction of critical configuration 7. Half-way rule wrt handstack limit 8. ¾ rule wrt handstack limit 9. Importance of proper source and detector geometry 10. Criticality safety impact of Process Changes in the work area 11. Criticality control selection criteria 12. Role of Judgment in selection of credible upsets and conditions 13. Criticality versus Conduct of Operations 14. Effect of moderators, reflectors, and precipitation (H/U) on critical mass 15. · Utility of hand calculations	
11:45	Lunch with Hand Calculational Methods Lecture (Part 1)	
13:00	Planet Approach to Critical/Critical Operations (cont.)	
17:00	End of Day	

Wednesday @ DAF EGS		
7:15	DAF EGS	
7:45	TACS Demo Part I	
11:45	Lunch with Hand Calculational Methods Lecture (Part II)	

Thursday @ DAF EGS		
7:15	DAF EGS	
7:45	LANL Advanced Hands on Demo 1. Understand when infinite reflector thickness is achieved 2. Demonstrate the geometric importance of reflector additions 3. Understand the sensitivity to different materials of fast versus thermal systems (absorption 4. versus scattering) 5. Measure the reactivity impact of human hands compared to poly shell thickness 6. · Measure the reactivity impact of human bodies compared to poly shell thickness	
11:45	Lunch with Experiment Criticality Accidents Lecture	
13:00	Course Attendee / Feedback	
17:00	End of Day	

Friday @ NSF		
8:30 AM	Three Site Course Critique	

Menu Selection needs to be provided
Ms. Kimberly R Scott (kimberlyr@lanl.gov)
no later than
One week before the class

NNSS Box Lunch Menu
Consists of a Sandwich,
1 Canned Soda or Bottled Water,
1 Bag of Chips, and
1 Pack of Grandma's Cookies
If Desired, Sandwich Can Be Replaced
With a Large Salad

Please Mark Your Choice
For Each Day:

Tuesday	Wednesday	Thursday
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐